Before Independent Hearing Commissioners appointed by Environment Southland

In the matter of	Application APP-20181129 by Southland District Council for resource consent to discharge treated wastewater to land and water, and to use land for construction of an effluent storage facility, for the Tokanui township sewage treatment system at 118 McEwan Street, Tokanui

Evidence of Sue Bennett

1 May 2019

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Qualifications and experience

1 My full name is Susan Bennett. I hold a BA (Hons) in Natural Sciences from Cambridge University, UK, where I specialised in Chemistry and Molecular Biology.

2 I am employed as a Principal Environmental Scientist with Stantec New Zealand based in Dunedin. Prior to joining the Dunedin office at the start of 1997, I worked for the same company (then known as MWH) in Hong Kong for five years.

3 I have over 27 years' experience in environmental consulting, primarily involved with wastewater, stormwater, solid waste and biosolids management. My specialist area is the environmental effects of discharges.

4 Since joining Stantec in 1991, I have worked on a range of environmental management projects in Hong Kong, Australia and New Zealand. Relevant projects to the Tokanui wastewater discharge in the Southland Region over the last ten years include the development of the proposed scheme and consenting of Te Anau, Tokanui, Riversdale and Nightcaps wastewater discharges, development of the wastewater strategy and biosolids strategy for Southland District, and changes to the Mataura wastewater discharge consent.

5 I acted as either technical lead for these projects, or as technical specialist providing input and review of the environmental effects, particularly in relation to effects on water quality.

6 I visited the Tokanui Wastewater Treatment Plant and surrounding area on 7 September 2017 during the development of the application.

7 I have been an elected member of the Technical Committee for the New Zealand Land Treatment Collective since 2017. As a member of the Environment Institute of Australia and New Zealand, I am bound by their Code of Ethics and Professional Conduct[1].

8 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

[1] https://www.eianz.org/membership-information/code-of-ethics-and-professional-conduct

Scope of evidence

9 My evidence includes:

(a) Summary of the information on the effects of the discharge on water quality and ecology;

(b) Assessment of the effects of the discharge;

(c) The impact of the addition of the infiltration trench on the effects of the discharge;

(d) Proposed monitoring programme.

Executive summary

10 There is sufficient information available on the nature of the discharge, the Tokanui River and the effects resulting from the discharge to be certain of the assessment of the effects of the wastewater discharges from the base of the ponds and proposed infiltration trench and directly to the river.

11 The impact of the existing treated wastewater discharge on surface water and aquatic ecology is considered to be less than minor and the impact on groundwater is considered to be minor.

12 The addition of the infiltration trench before the discharge to the river will reduce volume and frequency of discharge to the Tokanui River, and the planting of the trench will result in a number of beneficial effects.

13 The proposed monitoring programme is considered appropriate to confirm that the ongoing effects of the discharges are as determined.

Information on Effects of Discharge

14 I will provide a brief summary of the available information on the nature of the discharge and receiving environments and the effects, as presented in the Assessment of Environmental Effect (AEE) in the application and the subsequent investigations performed in 2019.

Quantity of Treated Wastewater Discharge

15 The inflow to the oxidation ponds has been measured on a daily basis between 2013 and 2017. The discharge to the River cannot be directly measured and was assessed for a number of summer and winter scenarios, incorporating the effects of evaporation from the surface and seepage through the base of the oxidation ponds. Rainfall falling on the surface of the ponds will also impact the volume, but was excluded from the assessment.

16 This assessment indicated that during summer, there would be minimal discharge to the river for a substantial portion of the time, which is supported by the anecdotal report of the operators of the oxidation ponds. In winter, the discharge to the river was similar to the inflow to the oxidation ponds.

Quality of Treated Wastewater Discharge

17 Treated wastewater quality data has been collected twice yearly from 5 October 2005 to 28 March 2017 as required under the current consent and weekly sampling was conducted in August and September 2017, for a broader range of parameters. The results of each data set were consistent and indicated that the discharge is of good quality for an oxidation pond, as a result of the large size of the ponds compared to the population served as discussed in Mr Hoffmann's evidence.

Tokanui River

18 The Tokanui River drains foothills and farmland in southeast Southland, flowing to the sea in Toetoes Bay. The catchment is relatively small with some steep topography in the upper reaches. Rainfall in the area is regular and reasonably high. The river is classified as a lowland soft bed river in the Environment Southland proposed Southland Water and Land Plan (pSWLP) and Regional Water Plan (RWP).

Available Dilution

19 A synthetic flow record was generated for Tokanui River between 2013 and 2017 by translating the daily record from the Environment Southland gauge on Waikawa River at Biggar Road. This daily record was compared on a daily basis to the inflow to the oxidation ponds. The inflow was typically several orders of magnitude less than the river flow, and the minimum dilution available was 343 fold based on full mixing, which was used as the basis for the prediction of water quality effects. This is considered a conservative estimate as these low dilutions would occur in the summer when the inflow to the WWTP will be more than the discharge to the River.

20 On page 36 of the S42A report, Mr West discusses the zone of reasonable mixing referenced in Policies 15A and 15B of the proposed Southland Water and Land Plan (pSWLP). The definition of "reasonable mixing zone" in the pSWLP includes, amongst other elements, that the zone be limited to two thirds of the river width. Mr West states that this would limit the available flow for dilution assessment to two thirds of the total flow in the river. I note that the definition also states in part d) "a distance determined through a resource consent process, having regard to (a) to (c) of this definition". Therefore, the

definition provides a guide to be used in a resource consent process to define the mixing zone rather than a fixed definition.

21 Dependent upon the shape of the river bed, the application of a mixing zone which is two thirds of the wetted channel would generally result in more than two thirds of the flow being available for dilution. However, on a conservative basis, I have used this translation to determine the impact of a reduced available flow (ie 2/3 of full river flow) on the assessment performed in the application, which was based on the full flow.

22 A theoretical worst case assessment of effects from the discharge based on the maximum recorded concentration in the treated wastewater and the minimum available dilution was presented in the AEE for biochemical oxygen demand (BOD_5), ammoniacal nitrogen, total nitrogen and total phosphorus. Reducing the minimum available dilution from 343 fold to 228 fold will result in the following changes to the predicted increases in water quality resulting from the discharge:

(a) BOD_5: the maximum recorded treated wastewater concentration was 50 mg/L, which would result in a theoretical maximum increase in BOD_5 in the river of 0.2 mg/L which would be indiscernible, and would have a minimal impact on dissolved oxygen concentrations in the river;

(b) Ammoniacal nitrogen: the theoretical maximum increase due to the discharge in the river would increase from 0.08 mg/L to 0.13 mgN/L. The relevant toxicity guideline is 0.9 mgN/L, and the maximum recorded concentration in the river was 0.4 mgN/L. Hence the maximum increase would still result in concentrations well below the toxicity guideline, which is the Plan standard.

(c) Total nitrogen: the theoretical maximum increase due to the discharge in the river would increase from 0.1 mg/L to 0.15 mgN/L, which would not change the assessment that the discharge will not affect the potential for nutrient effects in the river.

(d) Total phosphorus: the theoretical maximum increase due to the discharge in the river would increase from 0.08 mg/L to 0.1 mgN/L, which would not change the assessment that the discharge will not affect the potential for nutrient effects in the river.

23 Therefore, a reduction in the available dilution due to a reduced mixing zone to two thirds of the wetted channel would not affect the outcomes of the assessment performed and the effects on surface water quality would remain less than minor.

Water Quality

24 There are a number of sources of information on the water quality of the Tokanui River, including:

(a) Six monthly monitoring up and down stream of the discharge from the Tokanui WWTP from 2005 to 2017 as required by the current consent;

(b) Six monitoring events in August and September 2017 for a wider range of parameters than the consent required monitoring;

(c) Environment Southland State of the Environment (SOE) monitoring which is conducted at the crossing of Fortrose-Otara Road 8km downstream from the Tokanui WWTP. This was not included in the application but data from the site from 2009 to 2019 is summarised and compared to the consent required monitoring data in **Appendix A, Table 1**;

(d) Field parameters were also surveyed during the ecological surveys conducted by Ryders in October 2002 and April 2017.

25 In general, the Tokanui River has regular exceedances of the relevant guideline values, particularly those that indicate potential nutrient concerns. All sites also reported high concentrations of microbiological contaminants. The data from the various sources were broadly consistent and indicate that the wastewater discharge results in minimal change in water quality, which is likely to be primarily influenced by the predominantly rural surrounding land use.

26 Mr Hughes has summarised the information on groundwater in his evidence and showed that the discharge through the base of the ponds is having minimal effect on groundwater quality. The recorded groundwater contours indicate that the majority of the wastewater plume in the groundwater will intercept the Tokanui River before the surface water monitoring site which is located 150m downstream of the direct wastewater discharge to the River. Hence this site represents the effects on surface water quality of both the direct wastewater discharge and the discharge through the base of the ponds via the groundwater to the river.

Ecology

27 Ryders undertook ecological surveys in October 2002 and April 2017. The two surveys were consistent and showed minimal difference in macroinvertebrates found at the sites located up and down stream of the wastewater discharge, which indicate populations associated with poor to fair water quality. The MCI scores in the surveys complied with the Southland Plan standard.

28 Environment Southland undertake SOE monitoring of macroinvertebrates at their site, which is 8 km downstream of the wastewater discharge. Information from this monitoring has been summarised in Appendix 1, Table 2 along with the results of the 2017 Ryders survey. The SOE results are consistent with the Ryder survey and indicate macroinvertebrate populations indicative of 'fair' water quality.

29 The 2017 Ryder survey also surveyed the periphyton and macrophytes finding that there was minimal difference between up and down stream sites and no bacterial or fungal slime growths.

Effects of the Treated Wastewater Discharge

30 The major contaminant of concern within the Tokanui River is microbiological contamination. The upstream samples indicate that the stream is impacted by upstream land uses and cannot meet the national bottom line for freshwater for contact recreation. The quality of the discharge is such that it is expected that even when dilution levels are lowest, the discharge should not discernably alter water quality, after mixing.

31 The discharge will be an indiscernible contribution to the cumulative effect of point and non-point source discharges to the Tokanui River, or the wider Mataura Freshwater Management Unit (FMU) in which the Tokanui River is located.

32 The effects on surface water quality in the Tokanui River resulting from the discharge of treated wastewater both directly and via groundwater will be less than minor.

33 The application included a conservative assessment of the potential effects of the discharge through the base of the pond and the infiltration trench based on modelling. Mr Hughes has presented the recent investigations of the groundwater around the ponds which show that the model was overly conservative and the effect on groundwater quality is minor, with nutrients and microbiological contaminants in the treated wastewater being significantly reduced through treatment in the underlying unsaturated zone and aquifer.

34 The aquatic ecology surveys and the assessment of effects on surface water quality indicate that the adverse effects detected from the discharge on the aquatic ecosystems of the Tokanui River being less than minor. This finding was based on a lack of variation observed in invertebrate taxa richness, MCI or SQMCI scores between the upstream site and the downstream sites and is supported by the assessment of the water quality.

35 Therefore, the effects of the wastewater discharge on aquatic life and the life supporting capacity of the Tokanui River are considered minimal.

36 The effect on public health from the discharge from the WWTP can be broken into two categories, the risk to public health from contact with water and the risk to public health from the use of the groundwater as a drinking water source.

37 As discussed by Mr Hughes, the discharge from the base of the ponds will result in an increase in the concentration of microbiological contaminants in the groundwater above the NZDWS, as evidenced at the immediate downstream bore. However, groundwater in the vicinity of the WWTP is not used for potable water, and hence this will not impact on public health.

38 The assessment of effects on surface water indicates that the discharge has minimal impact on the degree of non-compliance of the Tokanui River with the contact recreation guidelines. The WWTP and the discharge from the WWTP are fully fenced. In addition the Tokanui River within the vicinity of the discharge is also fenced and there is a sign in place to warn people of the discharge. There is therefore limited access to the Tokanui River within the vicinity of the discharge and it is understood that this area of the river is generally not used for recreation. Therefore, the actual impact of the discharge on public health is considered minimal.

39 The groundwater concentrations recorded comply with the ANZECC 2000 Stock drinking water guidelines. Furthermore, groundwater is not used for stock drinking in the potentially affected area and hence impacts on stock of the discharge are considered minimal.

40 The discharge will have the following effects with respect to the requirements of S107 of the RMA:

(a) During my site visit in September 2017 and in the Ryder surveys, no conspicuous oil or grease films, scums or foams, or floatable or suspended materials were observed;

(b) I observed that the discharge itself was relatively clear and colourless. Algal concentrations could be higher in summer, which could increase the solids content of the discharge, but given the dilution available in the river, I consider that the discharge is unlikely to cause any conspicuous change in the colour or visual clarity of the river after discharge;

(c) As to be expected, there was some odour associated with the oxidation ponds themselves during my site visit. However, I did not detect odour at the discharge point during my site visit, and given the level of treatment

achieved, the discharge will not cause any emission of objectionable odour;

(d) As discussed above, the discharge will not cause the groundwater between the ponds and the River to be rendered unsuitable for consumption by farm animals. The Tokanui River does not comply with the stock drinking water guidelines upstream of the discharge and the effect of the discharge on water quality is minimal;

(e) The supporting information has indicated that the wastewater discharge will not cause any significant adverse effects on aquatic life.

Impact of the Infiltration Trench

41 The infiltration trench will provide an additional area for the discharge of treated wastewater to groundwater between the ponds and the Tokanui River. As discussed by Mr Hughes, this will not significantly change the impact on groundwater quality and will reduce the volume and frequency of the discharge direct to the stream. Hence, the addition of the infiltration trench will reduce the level of effect further from current low levels.

42 The proposed planting of the infiltration trench will help to reduce the discharge to the stream by evapotranspiration, groundwater levels as low as practicable, improve biodiversity due to inclusion of indigenous plants, and stabilise the bank of the river, as agreed with the submitters.

43 Given the assessment conducted, the effects from the existing discharge and as modified by the infiltration trench can be clearly defined with a high degree of certainty. The anticipated improvements as a result of the infiltration trench are also certain. Monitoring is proposed to confirm these predicted effects on an ongoing basis during the consent term.

Proposed Monitoring Programme

44 The following monitoring programme which is proposed to be included in the new consent was developed to confirm the effects which are predicted from the discharges from the scheme and includes:

(a) Monitoring of water level and analysis of samples of the treated wastewater, groundwater from all six installed groundwater bores and surface water from two surface water sites upstream and 150m downstream every six months for the first 2 years of the consent. This will include a period after the infiltration trench has been commissioned.

(b) Monitoring of quality of treated wastewater and surface water from two surface water sites upstream and 150m downstream will continue on a six monthly basis thereafter.

(c) Monitoring of water level and analysis of samples of groundwater from four of the installed groundwater bores (excluding Bores 5 and 6) every two years thereafter in conjunction with the summer survey of surface water.

(d) Aquatic ecology surveys as conducted for the application every 5 years.

45 As indicated in Mr McKenzie's evidence, the adjacent land owner on whose land bores 1, 5 and 6 are located will allow continued monitoring of bore 5 for two years, but then wants the bore to be disestablished due to its effects on farming operations, as it is in the middle of the paddock. As indicated by Mr Hughes, bores 5 and 6 are both away from the determined direction of travel of the plume, and represent the impact of surrounding landuse on groundwater rather than the wastewater discharge. Bore 1 represents background groundwater quality in the aquifer. Bores 5 and 6 are primarily useful in determining the groundwater contours in the surrounding aquifer. Two years is considered sufficient to confirm the interpretation of the results of the March 2019 survey over a number of seasons in terms of groundwater gradient and quality, and hence discontinuing monitoring at bore 5 and bore 6 after the first two years is considered appropriate.

46 Given that the majority of the wastewater plume in the groundwater will enter the Tokanui River before the surface water site located 150m downstream of the direct discharge, the effect of this discharge can be monitored through the surface water monitoring and hence the groundwater monitoring could be appropriately discontinued after a period. This has not been included in the proposed conditions at this stage.

Conclusion

47 The impact of the existing treated wastewater discharge on surface water and aquatic ecology is considered less than minor. The impact of the existing treated wastewater discharge on groundwater is considered minor.

48 The addition of the infiltration trench before the discharge to the river will reduce volume and frequency of discharge to the Tokanui River, and the planting of the trench will result in a number of beneficial effects.

49 The proposed monitoring programme is considered appropriate to confirm that the ongoing effects of the discharges are as determined.

Susan Bennett

1 May 2019

Appendix 1

Figure 1: Tokanui River State of the Environment Monitoring Location (Source: Google Earth)

Table 1: Comparison of Environment Southland State of the Environment site against consent required monitoring

	Minimum			Arithmetic Mean			Maximum			
Parameter	**Upstream**	**150 m D/S**	**SoE D/S**	**Upstream**	**150 m D/S**	**SoE D/S**	**Upstream**	**150 m D/S**	**SOE D/S**	**Guideline Values**
Ammoniacal Nitrogen (g/m^3)	0.01	0.01	0.01	0.06	0.05	0.03	0.40	0.40	0.39	0.9[2]/1.47[3] /0.021
Conductivity (mS/m)	16.2	17.1	151	18.1	18.4	195	19.8	19.9	219	
Temperature (^{o}C)	8.5	9.1		11.2	11.7		16	15.1		
E.coli (cfu/100mL)	30	359	10	1,315	1,275	2,869	9,208	6,380	110,000	
Faecal coliforms (cfu/100mL)[4]	42	503	10	1,841	1,784	2,933	12,891	8,932	110,000	1000[5]
Dissolved Oxygen (mg/L)	8.9	7.1		10.5	9.7		18.7	11.9		5[6]
Dissolved Oxygen (%)[7]	79	70		95	89		162	105		80[9]
pH	6.5	6.4	6.5	7.2	7.2	7.3	7.6	7.6	7.7	7.2 – 7.8
Nitrate-Nitrogen (g/m^3)	0.21	0.29	0.052	1.02	1.03	1.03	1.40	1.39	1.78	0.444[8]
Dissolved Reactive Phosphorus (g/m^3)	0.006	0.006	0.004	0.033	0.027	0.019	0.170	0.050	0.063	0.01
Turbidity (NTU)	4.4	4.8	2.9	10.3	10.5	16.9	22.5	25.2	125	5.6

Note: values which do not meet the Environment Southland plan standards are highlighted in red, values that do not meet the A NZECC physical and chemical stressors trigger values are highlighted in green.

[2] Toxicity value for 95% protection level

[3] Environment Southland plan standard, based on worst case scenario (highest pH)

[4] Faecal coliforms calculated using the concentration of *E.coli* and a conversion factor derived from six weeks of additional monitoring which analysed for both *E.coli* and faecal coliforms

[5] Environment Southland plan standard

[6] National Policy Statement for Freshwater grade B 1-day minimum standard

[7] Converted from concentration using reference table 4500-O:I in *Standard Methods for the Examination of Water and Wastewater* (22nd Edition). Assumes a typical atmospheric pressure of 101.3 kPa and that chlorinity in the river is zero.

[8] Value for nitrate + nitrite – in general nitrate makes up the majority of the two and therefore in the absence of specific data the concentration of nitrate has been compared to this trigger value.

Table 2: Tokanui River State of the Environment Macroinvertebrate Assessment

Source	Date	Location	Number of EPT taxa	MCI	MCI Category[9]	% EPT	SQMCI	SQMCI Category
Environment Southland SOE	26/01/2011	Tokanui River Fortrose Otara Road	7	86	Fair	35	4.49	Fair
Environment Southland SOE	27/01/2013	Tokanui River Fortrose Otara Road	3	80	Fair	25	4.71	Fair
Environment Southland SOE	19/03/2014	Tokanui River Fortrose Otara Road	8	85	Fair	42.11	4.84	Fair
Environment Southland SOE	19/03/2015	Tokanui River Fortrose Otara Road	4	78	Poor	0.91	4.61	Fair
Environment Southland SOE	24/02/2016	Tokanui River Fortrose Otara Road	3	80	Fair	0.96	4.25	Fair
Environment Southland SOE	9/03/2017	Tokanui River Fortrose Otara Road	2	73	Poor	0.04	4.46	Fair
Environment Southland SOE	16/01/2018	Tokanui River Fortrose Otara Road	8	79	Poor	6.31	2.91	Poor
Environment Southland SOE	-	Minimum	2	73	Poor	0.04	2.91	Poor
Environment Southland SOE	-	Median	4	80	Fair	6.31	4.49	Fair
Environment Southland SOE	-	Maximum	8	86	Fair	42.11	4.84	Fair
Ryders	April 2017	Tokanui River Upstream (Average)		88	Fair		4.1	Fair
Ryders	April 2017	Tokanui River Downstream 1 (Average)		83	Fair		4.2	Fair
Ryders	April 2017	Tokanui River Downstream 2 (Average)		83	Fair		4.1	Fair
	ES pSWLP Appendix E[10]			>80			>3.5	

Note: Results that do not meet the pSWLP standards are highlighted in red text.

[9] Based on interpretation of macroinvertebrate community index values from Stark and Maxted (2007)

[10] Environment Southland proposed Water and Land Plan, Appendix E – Water Quality Standards for 'Lowland Soft Bed' waterbodies